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ANNUAL REPORT OF THE

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

FOR THE CALENDAR YEAR 1938

TRAINLOAD OF PONDEROSA PINE LOGS -- 10 TO THE 1000 BOARD FEET -- CUT IN THINNING A 95-YEAR-OLD STAND ON THE PRINGLE FALLS EXPERIMENTAL FOREST.

PORTLAND, OREGON

MARCH 15, 1939

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EXPERIMENT STATION

REPORT OF THE
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOR THE CALENDAR YEAR 1938

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FOREWORD

The problems to which the work of the Pacific Northwest Forest and Range Experiment Station pertains are fundamentally those of land use. They have to do with the protection, development, and orderly use of forest and range lands so that these lands may, now and in the future, best serve the people of the community, the region, and the nation.

The North Pacific Forest Region, comprising all of Oregon and most of Washington, contains nearly 51 million acres of forest land. Of this, approximately 42 million acres are commercial forest land; that is, unreserved land which bears or is capable of bearing tree species of commercial value, where the rate of tree growth is reasonably rapid, and which is sufficiently accessible to make timber production economically feasible. The balance, or approximately 9 million acres, consists of land now unsuitable for the commercial production of timber and principally valuable for grazing, recreation, and watershed protection.

Of the commercial forest lands, approximately 27 million acres still bear merchantable timber, with a total volume of over 743 billion feet. The harvesting of this great supply of timber should proceed with due regard for the stability of the many local communities dependent upon it, and by methods which will insure the continued productivity of the forest soils.

Of the lands thus far cut over, or upon which the original values of virgin timber have been destroyed by fire, wind, insects, or disease, about 9 million acres, or 60 percent, now bear reproduction of at least a satisfactory degree of restocking. The remaining, 6 million acres, or 40 percent, is entirely denuded or bears a very partial and unsatisfactory degree of restocking. The foregoing figures indicate that the accomplishment to date in the Pacific Northwest has not been fully satisfactory. Were we to continue upon the basis of the past the end result would be that only 60 percent of the commercial forest area of the region would be in a productive condition--a state of affairs decidedly unhealthy for the future economic and social development of the region.

We have two major tasks before us--to reestablish reproduction upon forest lands now not satisfactorily restocked and to manage and harvest the remaining virgin timber so as to insure satisfactory regeneration and local and regional economic stability. Many problems must be solved before these objectives can be obtained. Some will involve further developments of logging technique, better methods of slash disposal, and more effective methods of providing a seed supply. Others will necessitate alterations in our systems of land ownership, taxation, and our conceptions of the relation of land use to economic stability. More information is needed on the best types of utilization of the timber species occurring in the region. Logging studies made in relation to the economic aspects of timber harvesting would provide information of immediate and direct value to logging practice. Last, but not least, the great and intricate problem of fire protection must be solved. No system of forest management can result in the growing of timber upon these lands until they are protected from fire. To accomplish this, further advances in fire prevention and suppression

technique and also a quite fundamental alteration in public opinion regarding forest fires will be necessary.

The North Pacific Region contains 62 million acres of land useful for grazing, mostly east of the Cascade Summit. Of this total, 27 million acres are summer range, lying mostly at higher elevations in the more mountainous localities. Much of this summer range is forested and some of it lies within the belt of commercial forest land. The balance of the area, 35 million acres, consists of spring-fall range. Winter feed in Region 6 is almost entirely supplied from locally grown hay.

The spring-fall ranges of the region have a larger carrying capacity than the summer ranges. This discrepancy is the source of many of the difficulties which the livestock industry faces in this region. These ills in many cases have been aggravated by the overstocking of the spring-fall range. In order to meet the demand for summer range built up by the full or over-use of the spring-fall ranges, the available summer ranges have in all too many instances been subjected to severe overgrazing. This has resulted in serious depletion of the range resource on both the summer ranges and spring-fall ranges, with all of the attendant ills of loss of soil fertility and accelerated soil erosion. In many localities the problems are further aggravated by sharp competition for available forage between domestic livestock and game, and by lack of information regarding the effect of grazing upon timber reproduction and the proper relation between livestock and timber production upon the same area.

To insure a permanent, prosperous livestock industry within this region and to integrate that industry with the other uses to which some of the lands concerned are of value, many problems must be solved. A balance is needed between the demands for spring-fall range and for summer range. Where the range resource has been depleted means must be developed to improve it. To gain the highest use from certain portions of the range area the problems attendant upon its simultaneous use for range and for timber production must be solved. And, finally, means must be devised to harmonize the use of many areas for livestock production, game production, recreation, and watershed maintenance.

Determination of the most advantageous use for many areas of logged-off land in western Oregon is a difficult problem. Two proposals have been made--continued production of forest products and alteration of the original vegetative type into grass lands suitable for grazing. Assuming that a well-rounded economy for western Oregon might well include both a timber-growing and a livestock-producing industry, the problem becomes more specific. Can a sod useful for forage and adequate to protect the soil from deterioration be established and maintained upon all or some of these lands? If experimentation proves this

to be the case, it will then be necessary to determine, local area by local area, which land use will permanently support the larger population upon an adequate economic basis.

The foregoing brief discussion has endeavored to indicate the major problems of land use in this region. Their solution necessitates increased knowledge of the physical, biotic, and economic factors involved. The following discussion is an account of the work of the Pacific Northwest Forest and Range Experiment Station which is directed at the solution of these problems.

FOREST MANAGEMENT

Silvical Studies in the Fir Region. Much knowledge is now available on the behavior of Douglas fir in even-aged stands such as life of seed in the soil, distance of seed flight, effectiveness of seed trees, rate of restocking on different sites, effect of burning on soil and cover, causes of seedling loss, and planting and broadcast seeding technique.

A milepost of progress in the field of even-aged silvics was the publication this year of U.S.D.A. Circular No. 486, "Factors Affecting Establishment of Douglas Fir Seedlings." It showed an 80 percent first year seedling loss from drought, rodents, frost, and heat. White-footed mice took half of one year's seedling crop; shade was protection against both heat and frost injury and "dead shade" was more beneficial than living shade. The next step, now well under way, is to gather together from old and new studies all available information and summarize it in a general bulletin on regeneration in the Douglas fir region.

The introduction of the tractor in logging and a consequent trend from complete clear cutting to some form of partial cutting has precipitated a brand new set of problems. An analysis of 37 permanent and temporary plots on partially cut areas on both private and national forest land is beginning to yield more valuable empirical information concerning the silvical results of partial cutting.

A "before and after" study was made of a 220-acre selectively logged tract of private land where 20 percent of the area was clear cut, 25 percent practically untouched and held for future markets, being now covered mostly with silver fir, and the remaining 55 percent lightly cut and the scattered high value Douglas fir removed.

The 13 permanent sample plots established in advance of selective logging on national forest timber sales must be examined over a period of years to tell an accurate story of injury, decay, change in stand composition, regeneration, windfall, fire hazard, and new growth.

There must be more of these sample areas. But the greatest need at the present time is for larger experimental cutting areas which can be analyzed in advance of cutting, and then cut so as to apply existing silvicultural knowledge and test new methods.

One of the most puzzling phases of the silviculture of selective cutting in this region is the abatement of the slash hazard. Not even a beginning has been made in the research necessary to solve this problem though protectionists are looking to the Station to give the facts about the hazard and to suggest the best technique of fire control both following zero margin cutting and light selection cutting.

Silvics in the Ponderosa Pine Region. In the pine region attention has been focused on accumulating a sound knowledge of the silvics of the principal species and developing methods of cutting that will perpetuate the stand in its highest stage of productivity. Methods of logging and slash disposal which have been in vogue on private lands, while ordinarily not devastating large areas, fail to keep the land productive to even a fair percentage of its potentiality. To get full productivity woods practices must be improved. In this region seedlings of ponderosa pine become established only at infrequent intervals and most of the seedlings that germinate die in their first year. On 50 acres of sample plots on selectively cut land on the Rogue River National Forest no seedlings have become established in the 10 years since cutting. In the Blue Mountain region test areas show only enough establishment of subsequent reproduction to compensate for mortality.

Past studies in the fields of silviculture, mensuration, logging economics, and utilization have pointed strongly toward the desirability of a lighter cut than heretofore employed on the national forests. A method of cutting has been devised called the "maturity selection system" which has found favor and is being tried on a large scale. Recent silvicultural research in the pine region has been directed largely to testing the results of this method. On the Malheur National Forest a set of 400 permanent sample plots and a 50-mile transect upon which mortality can be checked were established this year. There is a growing appreciation that satisfactory quantity and quality growth following cutting depends on the structure of the residual stand, because trees of various classes show striking differences in behavior. It is to determine the mortality probability, the response to release, the growth capacity, wind firmness, and other silvical facts about each class of tree that our studies are now principally directed, through long-term observations of permanent plots and large-scale experimental cuttings.

Regeneration. This Station has begun practically nothing in this field this past year and has only a minor amount of work continuing from previous years. It is not from lack of significant problems that this field is not being more adequately covered. Much remains to be done particularly in the technique of handling species other than

Douglas fir and ponderosa pine. With probability that some of the millions of acres of private logged-off lands, half of which are unsatisfactorily stocked, will eventually come into some form of public ownership, it appears that there will be a great amount of artificial reforestation to do, which will involve new problems for research, such as planting in brush, choice of species and seed source, cheapening the technique, and combating the biotic enemies of seed and planted stock. The Station is constantly broadening its knowledge of this field as results accumulate from the extensive planting work being done by the Regional Forester, from new planting and sowing tests, from the arboretum and from the older planting experiments. The Biological Survey is doing work in the study of the relation of animals to reforestation and in the control of rodents.

Genetics. In the field of genetics there are two sets of plantations, one of fir and one of pine, which are being followed through a long term of years, and which are already helpful in showing desirable seed sources for reforestation. A great deal more should be done in the study of regional strains, for the local variations in pine and fir, and probably other species, are pronounced and have an important bearing on source of seed to produce for each planting site the hardiest and most rapid-growing stock.

Mensuration. The principal objective of the mensuration projects is to provide methods of easily and accurately determining the volume of timber and its rate of growth. Standard volume tables have already been constructed for the species of leading commercial importance. Normal, even-aged yield tables have heretofore been made for even-aged Douglas fir, even-aged spruce-hemlock, and selectively cut ponderosa pine. The past year's addition to the series was U.S.D.A. Technical Bulletin No. 630, "Yield of Even-Aged Stands of Ponderosa Pine." This publication, resulting from an interregional study of the type, provides a basis for estimating growth of even-aged ponderosa pine stands throughout the range of the species. During the past year further study of growth prediction in selectively cut ponderosa pine stands has been made with a view to developing growth-predicting technique so that it may be validly and readily applied to stands lightly cut over under the maturity selection system.

Stand Improvement. Stand improvement is a subject to which the Station is devoting an increasing amount of attention in response to growing interest in these activities. Thinning in merchantable stands has been initiated this year on both the Wind River and the Pringle Falls Experimental Forests. At Wind River six extensive methods of thinning plots have been established in 97-year-old Douglas fir. This demonstration includes low and crown thinning, thinning for uniform spacing regardless of crown class, as well as logger-selection thinning.

At Pringle Falls in a 95-year-old even-aged ponderosa pine stand a 40-acre "thinning from above" has been made and the logs removed and sawn into lumber.

A study of factors associated with development of trees suitable for piling revealed a significant correlation between stocking and proportion of trees that are suitable for piling. In a stand 50 percent stocked only 23 percent of the total number of trees are, on the average, suitable for piling while in fully stocked stands 42 percent of the trees will make piles. Since second-growth Douglas fir, if suitable for piling, is about twice as valuable for this use as it would be for saw timber, it is clear that by improving stocking not only is total volume increased but the value per unit of volume is also materially improved.

The need for and the value of artificial pruning is being considerably clarified by a study of knot formation and natural pruning in second-growth Douglas fir.

Another phase of stand improvement is being conducted with the assistance of two CCC Junior Foresters who have recently completed examinations of several areas on national forests that have already been thinned or pruned by CCC crews. Based on this examination, principles of thinning and pruning technique, and crew organization have been drawn up and put into practice on an experimental basis on two national forests. Time studies being made will permit a more accurate estimate of net value of the stand improvement practices that now appear to be most promising.

Fire Control Planning. Working in collaboration with the Regional Forester's office, principles and procedures were developed by which the number and placement of lookouts, firemen, roads, and trails necessary for quick control of fires can be determined. Procedures were devised to determine the point of diminishing returns by balancing the costs of fire control facilities against the benefits of being able to control fires during the first day with the least number of men. A complete sample analysis and plan of coordinated fire control facilities was made for one ranger district to develop and demonstrate the method. Additional work is necessary to make some of these new developments mesh into the fire control planning program of the region.

Classifications of forest fire fuels according to the probable rate of spread and resistance to control as developed here were found to be a valuable aid in determining the increase in fire hazard on partial cut pine lands compared to uncut timber.

Fire Danger Rating. The fire weather measurements, the fire danger board, and the specifications for manning according to the fire danger have been welded into a complete fire danger rating system. With total fire control expenditures exceeding a million dollars in this region during the past year, the importance of obtaining an accurate appraisal of fire danger is apparent. With such large sums at stake, fire danger rating, already an important tool in national forest administration in Region 6, deserves even more attention.

Improvement in the fire danger rating system has been made in determining the combined effect of weather, fuel, visibility, and fire-starting factors upon fire danger. Analysis of field records has shown that measurement of the fire-causing factors needs additional improvement. A study was made of the critical moisture contents which determine the ignitibility of fuels and it was found that rotten wood up to 40 percent moisture content is ignited readily by cigarettes but is not ignited by matches when more than 8 percent moisture content. Bracken fern, cheat grass, and pine needles, up to about 35 percent moisture content, were readily ignited by matches. When very dry these fuels were even more readily ignited by matches than by cigarettes.

The results of the studies of fire danger rating are available to all fire-control agencies in the region, and are used by some outside the national forests. Outside lands need fire danger rating just as much as the national forests; therefore, there is still a large and important undeveloped field for the application of this system.

Fire Behavior and Control. Ten going fires were studied during the season. Attention was focused almost entirely upon measuring the effect of fuel conditions, wind velocity, and topography upon fire behavior on small segments of each fire. A large logged-off land fire outside the Olympic National Forest was found to be spreading rapidly because of gentle to moderate winds even though the weather was cloudy and the relative humidity was high. Such information on the rate of spread under various conditions is necessary for proper fire danger rating and planning of fire control facilities.

The use of chemicals in controlling fires was studied for three weeks in collaboration with a crew from the Forest Products Laboratory. Two hundred and twelve pairs of small fires were studied in which the amount of chemical to extinguish one fire in a pair was compared with the amount of water to extinguish the other. Logs and branches, rotten wood, bracken, and fir slash were each used. The results showed that the best chemicals known are less than twice as effective as water.

Fire Effects. Fire control, the foundation of silviculture in this region, is being made more expensive and uncertain on public and private lands in parts of western Oregon and Washington by the use of fire to promote grazing on cut-over lands. This problem of conflicting land use has become most acute in Curry and Coos Counties in Oregon, but is more or less general in the coastal counties. Although the Station is unable to make any fire-effects studies under present allotments, we have been forced to spend some time on this situation in order to be able to state the problem and suggest how it should be studied.

FOREST PRODUCTS

Mill Production Studies. Since 1935 mill production studies in the ponderosa pine territory have taken priority. These studies, from which are derived log marginal values, are fundamental to the selective logger and are essential in appraisals of government stumpage.

Six studies have been completed. These have (a) provided lumber-grade recovery data on approximately 5,000 logs, (b) led to the establishment of a set of log grades which are apparently fundamentally sound and of region-wide application, (c) permitted the development of new and more accurate methods of determining milling costs for logs of different sizes, and (d) pointed the way to a more accurate determination of values and recoveries in defective logs.

The ponderosa pine log grades proposed in 1935 have been given a thorough check through actual use in both mill and woods. They have proved to be easily used with a minimum of variation between graders, to give consistent estimates of lumber recoveries and log values, and apparently are applicable throughout the ponderosa pine territory. Six grades of logs are recognized, based entirely upon surface appearances and thus applicable in standing trees as well as upon the log deck. No diameter limits are imposed, and the grader is not required to estimate yields of any grades of lumber. The successive grades permit the inclusion of increasing knottiness or roughness, beginning with Grade 1, which is essentially surface-clear, and ending with Grade 6, which is very rough. Grade 1 logs produce, on the average, approximately 40 percent of Selects, 10 percent of Shop, and 50 percent of Common. Grade 2 logs, being three-fourths surface clear, produce less Select and more Shop, while Grade 3 logs, segregated principally upon a Shop knot spacing, yield high proportions of Shop. Grade 4 logs, sound-knotted, are high in 2 Common; Grade 5 logs, black-knotted, are high in 3 and 4 Common.

During the year, the sixth in this series of studies was conducted at Lakeview, Oregon. A 50 M capacity mill producing 60-65 percent Box lumber was selected. Previous studies had been made in large mills with varying degrees of manufacturing refinement. In addition, five sawing-time studies were made in order to obtain data basic to a calculation of the effect of equipment on milling costs. A large proportion of the office time was given over to the analysis of an unusually complicated and involved study conducted at Flagstaff, Arizona, by the Southwestern Station. This necessitated separate analysis of tie and lumber logs, defective and sound logs, and tree selection and log selection in the woods.

Office reports, of which copies are furnished the cooperating companies, have been prepared for the two mill studies conducted in 1937, for the production study and the five sawing-time studies made this year, and for the two phases of the Arizona study.

Early this year work will start on a regional report for publication. This will combine the procedures followed and the results obtained in all the ponderosa pine studies. It will contain (a) the lumber grade recoveries to be expected from logs of different sizes and qualities, (b) the effect of manufacturing procedures upon these recoveries, (c) an analysis of costs of manufacturing logs of different diameters, lengths, qualities, and degrees of defect, (d) a regional log rule based upon actual lumber recoveries from 10,000 sound logs, and (e) the influence of various degrees of defect upon log values. All of these are fundamental to economic tree selection. All of this year's Forest Service sales and exchanges of ponderosa pine in Region 6 have been based upon stumpage values calculated from log values established by our studies. One operator has used the data for three years; this year two other large operators have negotiated sales and exchanges based upon results of these studies.

The need at present is for similar information regarding Douglas fir. The Station should provide the unbiased data which the operators are ready for and anxious to get. With this in mind it is planned to devote the first half of 1939 to (a) completion of several study reports and (b) to preparation of the regional report on ponderosa pine log values. The latter half of the year should be given over to preliminary work in Douglas fir.

Statistics. The collection and interpretation of production and price statistics have continued. The 1937 census of lumber, lath, and shingle production was conducted in cooperation with the Bureau of the Census; log, shingle, and minor products prices have been compiled and released; export data on logs, burls, and cascara bark have been kept current. The inclusion of contract loggers in the annual census has considerably increased the work in this region, because more and more sawmills are contracting the logging from their own holdings. Ponderosa pine production continues to increase at a greater rate than any other species. The 1937 regional production of all species exceeded that of 1936 by 4.8 percent; the Douglas fir increase was 3.8 percent, the ponderosa pine increase 13.2 percent.

At the request of the Regional Forester's office a survey of trends in the forms of pulpwood used was made. Previous to and immediately following the World War about 90 percent of the wood supply was purchased in log form. During the 1921 depression cordwood came to the fore, because of unemployment and wage decreases, so that by 1925 one-third of the requirements were in this form. Mill waste entered as a major source of supply coincident with increased production of hemlock lumber, and in 1930 formed one-third of the material used. During depression years the supply of mill waste was sharply curtailed; cordwood again came to the fore, but was quickly supplanted by logs. In 1934 logs supplied 67 percent of the requirements, cordwood 23 percent, and mill waste 10 percent.

Preservatives. In spite of earlier unsatisfactory performances of the same preservative in powder form, Anaconda paste, an arsenic compound, has come into quite universal use as a pole preservative, probably because it could be applied by CCC labor on poles cut along the right-of-way. Since 1933 some 21,000 national forest poles have received this treatment in Oregon and Washington. In 1936 and 1937, 100 poles in each of 11 lines, selected as a cross section of soil and climatic conditions and species used, were selected for periodic examination. Decay was present in 19 poles in 3 of the 7 Oregon test lines inspected in 1938, but it is too early to draw conclusions as to effectiveness of the preservative or as to the contributory factors in the poles showing decay. Two additional lines were established during the year; in both of them treated and untreated poles are alternated. Plans for 1939 contemplate (a) inspection of the 4 lines in Washington, (b) maintaining records of all new paste-treated installations, and (c) tagging and describing the two lines installed this year.

FOREST SURVEY

The first objective of the forest survey in Oregon and Washington was achieved with the completion of field work and basic computations for the inventory, growth, and depletion surveys of the ponderosa pine region. Reliable basic information is now available for intelligent consideration of forest problems and formulation of comprehensive management plans for the forest resources of both the Douglas fir and ponderosa pine regions.

Ponderosa Pine Region

Inventory Phase. Basic inventory computations were completed and results published in Forest Research Notes No. 25, "Forest Statistics for Eastern Oregon and Eastern Washington", which presents saw-timber volume by species and ownership, and forest land area by cover type, site class, and ownership. It shows that this area has 24.7 million acres of forest land of which nearly half supports ponderosa pine saw-timber stands. The total saw-timber volume is 132.4 billion board feet, log scale; half national forest, one-third private, and the remainder other public or Indian owned. The total ponderosa pine volume is 83.4 billion board feet.

Publication of the lithographed forest type map of northeastern Oregon completed the series of 8 maps which entirely cover Oregon and Washington. Approximately 4,600 copies of these maps have been distributed; 3,100 without charge to public and quasi-public agencies and 1,500 copies sold.

Unquestionably determination of board-foot volume is one of the most valuable results of the survey for saw timber is the leading

product of the region's forests. However, an inventory limited to this standard would leave unmeasured almost one-third of the region's total growing stock. The solid wood volume in forests of eastern Oregon and eastern Washington, exclusive of Stevens, Pend Oreille, and Spokane Counties, totals 31 billion cubic feet. Of this total volume 70 percent is contained in potential sawlogs, 10 percent is in tops and stumps of trees of sawlog size, and the remaining 20 percent is in trees less than sawlog size (5.1 inches to 11.1 inches d.b.h.) about one-half of which is in the understory of saw-timber stands, and one-half in second-growth stands. Although nearly two-thirds of the board-foot volume is ponderosa pine, this species forms only one-half of the cubic-foot volume.

Depletion Phase. Basic compilation of cutting and fire depletion data has been completed and results are being tabulated in final form.

Analysis of cutting depletion data shows that the average annual sawlog production in the ponderosa pine region for the period 1925 to 1936, inclusive, was 1.2 billion board feet. Of this volume approximately 68 percent was cut in eastern Oregon and 32 percent in eastern Washington. Ponderosa pine formed about 87 percent of the total. The annual output of minor forest products such as fuel wood, fence posts, and poles was approximately 217 million board feet, log scale, of material cut from trees of saw-timber size and 3 million cubic feet of material cut from smaller trees.

During the period 1924 to 1935, inclusive, fire burned over an average of 85,467 acres of forest land annually in eastern Oregon and eastern Washington. Area deforested annually during this period averaged 37,107 acres and volume of timber killed annually averaged 94 million board feet, log scale. Of the timber killed, an average of 7.6 million board feet annually was salvaged.

Growth Phase. Estimates of current, periodic, and potential growth were completed during 1938 for all forest land in eastern Oregon and for that part of eastern Washington in Region 6. A regional summary of current and of potential growth follows:

Current and Potential Growth in Eastern Oregon and Eastern Washington[1/]

Kind of growth calculation	Area	Annual growth of Trees 5.1" or more in d.b.h.	Annual growth of Trees 11.1" or more in d.b.h.
	Million acres	Million cu. ft.	Million bd. ft.
Current annual gross growth in			
1. immature stands	4.1	162	258
2. virgin stands	11.6	182	891
Total	15.7	344	1,149
Current annual net growth in immature stands	4.1		
Ponderosa pine		66	105
Other species		72	114
Total	4.1	138	219
Potential annual net growth			
Ponderosa pine sites	12.0	436	1,410
Other commercial sites	4.1	222	627
Total	16.1	658	2,037

1/ Exclusive of Stevens, Spokane, and Pend Oreille Counties.

Current annual net growth of saw timber, 219 million board feet, is but one-fifth of the total current gross growth. In virgin stands, where three-quarters of the gross growth is occurring, increment is being offset by mortality owing to prevalence of mature and overmature age classes in the stand. Through proper forest management, the gross increment occurring on these areas could be converted to useful net increment.

The potential annual net growth, 1,410 million board feet for ponderosa pine sites and 627 million board feet for other commercial forest sites, is an estimate of increment attainable under intensive forest management. Ponderosa pine sites include two-thirds of the region's growth capacity, but owing to the greater prevalence of over-mature stands on these sites less than one-half of the current net growth is being added to ponderosa pine trees. The difference of 0.4 million acres between area for which current annual growth was computed and area for which potential annual growth is computed was accounted for by deforested burns and cutovers.

Periodic saw-timber growth estimates have been made for the next 30 years, assuming future cutting and fire depletion rates. If

past cutting practice continues, i.e., heavy selection cutting on public lands and virtual clear cutting on private lands, the average annual net increment that will occur in immature stands over the next 30 years will be 380 million board feet, of which 240 million will occur in ponderosa pine stands. However, merely by substitution of light selection cutting in pine stands the average net increment in the ponderosa pine types for that period can be increased to 380 million board feet; and the total net increment to 520 million board feet annually.

Plans for 1939. The major task for 1939 is the completion of the regional report. Analysis of ponderosa pine saw-timber volume by type, size class, and tree class groups and segregation of saw-timber volume in residual stands on cut-over lands is being made and results will be included in the report. A study of cutting budgets for transition to sustained yield management and ultimate sustained yield capacities will be made for geographic units and the region as a whole.

Results of the growth phase will be published in mimeographed form.

Douglas Fir Region

Inventory Revision. Compilation of revised inventory statistics for Grays Harbor County, Washington, and Clatsop County, Oregon, resulted in the publication of revised county reports and 1-inch-to-the mile type maps for these counties.

Field work on the inventory revision of Columbia and Coos Counties, Oregon, and Pacific, Pierce, and Snohomish Counties, Washington, was completed during 1938. A total of 5.3 million acres representing nearly one-fifth of the region's forest land has been reinventoried to date. The seven counties included are those in which cutting has been most active. Data now available for Grays Harbor, Clatsop, and Columbia Counties show that between 1933 and 1938 the aggregate saw-timber stand was depleted from 31.9 billion board feet to 26.5 billion board feet, practically all on private lands and principally the result of cutting old-growth Douglas fir. The stand of privately owned old-growth Douglas fir in these counties was reduced by approximately 40 percent during the 5-year period.

The resurvey conclusively shows restocking of cut-over areas is far from satisfactory. For example, 400 thousand acres were clear cut from 1920 to 1929, inclusive, and by 1938 only 45 percent of this area was stocked and not all of that satisfactorily compared to 55 percent absolutely nonstocked. An indication of future chances of restocking on this area can be obtained from the history of the older cutovers. The 1933 inventory showed 106 thousand acres clear cut prior to 1920 and nonrestocked; the 1938 inventory showed that 20 percent of this area restocked during the five years.

Study of Stocking of Spruce-Hemlock Sites. As a part of the recent inventory revision of Clatsop County, Oregon, and Grays Harbor County, Washington, a special study was made of the stocking of areas covered with immature spruce-hemlock stands. Such areas mapped as well stocked were found to average about 65 percent of the spruce hemlock yield table values. However, areas covered with Douglas fir stands that had been mapped as well stocked, under the same scale of stocking classification, averaged 85 percent of the Douglas fir yield table values. These two percentages indicate what part of the differences in these two yield tables is due to differences in standards of normality employed. A comparison of actual yields of extensive well-stocked Douglas fir stands with similar spruce-hemlock stands may be made by comparing Douglas fir yield table values multiplied by 0.85 with corresponding spruce-hemlock yield table values multiplied by 0.65. Following such computation the spruce-hemlock yield shows a superiority of 0 to 17 percent in cubic-foot volume, the difference increasing with age, and approximately 27 to 30 percent in board-foot volume at ages of 80 years or more.

Plans for 1939. The recompilation of Pacific, Pierce, Snohomish, and Coos Counties will be completed early in 1939 and county reports will be published soon thereafter. Revised type maps will be published for each of the above counties and Columbia County.

Field work is planned for six counties--Clallam, Cowlitz, King, and Lewis Counties, Washington, and Washington and Marion Counties, Oregon.

Service Jobs

Filling of special requests for statistical data relating to all phases of the survey has developed into one of the chief functions of the Forest Survey staff. Roughly, 250 man days were so occupied during 1938. Active users of the survey statistics in special form and maps included the Bureau of Entomology and Plant Quarantine, the National Park Service, the O. & C. Land Grant Administration, the Army Engineers, Soil Conservation Service, the Bureau of Agricultural Economics, and various divisions of the Regional Office. The Bonneville Administration have made extensive use of the type maps in locating transmission lines and the maps and statistical data in economic studies. Industrial users ranged from lumber and timber companies planning operations, some looking towards sustained yield, and companies seeking suitable locations for pulpwood and plywood plants to companies and individuals in the Christmas tree business.

FOREST ECONOMICS

Economics of Logging and Timber Management. Since 1935 studies of the economics of selective timber management have been concentrated almost exlusively in the ponderosa pine region. These studies, which have now been completed except for certain unfinished office reports, have already contributed in an important way to better forest management and hold the promise of still further progress as final results and cross comparisons between various case studies become available.

The ground work for the project as a whole, much of which has been reported on in previous years, consists of four major case studies, three of which were conducted within the territory normally served by this Station, while the fourth and last was made at Flagstaff, Arizona, which falls within the territory served by the Southwestern Station. Owing to the defective character of the timber and to sawing practices peculiar to the locality, this study unfortunately ran into many complications not previously encountered in similar studies in Region 6. This has delayed completion of the study far beyond expectation. At the close of the year there still remains a good deal to do on the formal office report, though all the work of computation and analysis is otherwise complete.

Despite the many dissimilarities found in the timber and in operating practices in the Arizona study, the results again point to the same general conclusions that have previously been reported for the three eastern Oregon studies, namely, that it is not only economically feasible but both silviculturally and economically advantageous to change to much lighter cutting than heretofore practiced. In the Arizona case the results thus indicate that a 22 percent cut--as contrasted with the present practice of removing about 70 percent of the stand--will produce the best results, but in view of various uncertainties the recommendation made is to try a 35 percent cut as a start with the possibility of changing to a still lighter cut if and as experience so warrants.

Corresponding results in the eastern Oregon studies, as previously reported, were substantially the same. Through such changes from heavy to light cutting many advantages are gained, such as (1) a substantial increase in present income from a given volume of cut; (2) an increase in both volume and value production per acre from the heavier reserve stands; (3) greater speed in going over the virgin timber areas in inverse proportion to the change in percentage of cut, and hence a further increase in production in both volume and value from the forest as a whole; (4) preservation of the forest climate and avoidance of drastic disturbance in the stand. Each of these and other related advantages are important and in toto, insofar as the study predictions prove to be true, they would combine to lift our cutting practice to a far higher level of accomplishment than before.

An interesting by-product of the Arizona study, and the same applies to the other studies, is the light it throws on the practicability of pruning. Here the indicated findings are that for each dollar invested in pruning butt logs of suitable reserve stand trees, the financial returns through the improved quality of timber after 50 to 100 years of growth will generally amount to $10 to $30, thus clearly indicating that pruning is a commercially profitable undertaking. Similar findings were recently made in the Hines study case, and this has since led to the initiation of a CCC pruning project on the Malheur National Forest, which is now attracting wide attention.

Plans for the first half of the coming year are first to complete the office report on the Arizona study and also to complete the so-called Kinzua case study report. Following the completion of these individual case study reports a regional report, embodying the findings of the individual case study reports will at once be started with hope for its completion during the first half of the year.

For the second half of the year, the plan is for the start--in cooperation with the Division of Forest Products--of as comprehensive a series of case studies in Douglas fir as that which has now been completed for ponderosa pine. Here the need for research leadership and pioneering is just as great as in the pine region and its importance even greater, since the timber resources and production in the region are much greater. During the past few years, following the pioneering work that culminated in the publication early in 1936 of the bulletin "Selective Timber Management in the Douglas Fir Region" by Kirkland and Brandstrom, practically no basic research work has been done in this region. At the present, interest in factual information on all phases of selective timber management in Douglas fir is greater than ever and the time seems opportune indeed for resumption on a reasonably large scale of work in this important region. This work, it is believed, will in all probability now prove much easier than before, owing to perfection of study technique as developed in the pine studies. This technique is as applicable in Douglas fir as in pine.

New Public Domain. New Public Domain studies at this Station have taken three interweaving paths: (1) formal analysis and report, (2) service to agencies and groups interested in tax-reverted land and related problems, and (3) cooperation with Federal, State, and local agencies engaged in land use and ownership programs.

Preliminary to the formal report, compilations of facts bearing upon instability of ownership of forest lands in western Oregon and western Washington were mimeographed and given wide regional distribution. These publications showed that within the sample counties studied approximately $\frac{1}{2}$ million acres had been forfeited to the counties for unpaid taxes and 3 million acres were involved in long-term tax delinquency. Further study revealed that most of these lands were forest. There ensued broad local and State attention to the immediate

problems of disposing of tax-forfeited lands, to improving laws dealing with tax delinquency, and to local public finance.

As a result of the analysis of the kinds of lands being forfeited for taxes, numerous counties in both States have discouraged the sale for farm purposes of county lands unsuited for such purposes. In some of the trouble areas disclosed by the study--as in southern Tillamook County--Federal agencies have acquired farms and stump ranches and turned them over to the Forest Service for management as forest lands. Despite these efforts and supplemental educational programs, unwise settlement continues and at present is increasing because of the amount of stump lands in speculative ownership and the influx of land-hungry people from the "Dust Bowl" seeking "green pastures" at low cost.

The consequent mounting costs of schools, roads, relief, and protection brought on a fiscal crisis in many Oregon counties and led county officials, groups of farmers and forward-looking owners of forest lands to recommend strongly the passage of rural zoning regulations which would tend to halt wasteful processes in land utilization. To this end representatives of the Forest Experiment Station, upon request, assisted in identifying and formulating sound principles which should be incorporated in an Oregon law. Such principles were formulated and a measure was drafted. These principles and the measure are being studied by representative groups of county officials, agriculturalists, forest owners, and chambers of commerce.

A formal report covering the results of the New Public Domain study in the Douglas fir region is in progress. Completion of this report takes priority over other activities.

Principles and methodology developed in these studies are being employed in land economic surveys being conducted by the State colleges of Washington and Oregon, the Bureau of Agricultural Economics, and the planning boards of the two States, in which work the Station is cooperating. Cooperation has involved supplying basic physical and economic data gathered by the Station, some supervision, and examination and criticism of reports. In addition, these studies have carried Station representatives to participation in the land planning activities of the Pacific Northwest Regional Planning Commission, including participation in preparation of the National Resources Committee report entitled "Forest Resources of the Pacific Northwest", March 1938. Continuation of this cooperation in 1939 is planned.

The crying need in the Douglas fir region is for physical, biotic, and economic criteria upon which landowners may determine the best use of cut-over and other forest lands with special reference to grazing or cultivation and timber production. The lack of this information is seriously affecting ownership and management plans for tax-forfeited lands and the administration of the fire protection laws of

the two States. It is hoped that studies in this direction may be initiated during the fiscal year 1940.

Studies in Local Government Adaptation. The property-tax problem in the mountainous and forested regions of the Northwest is inextricably bound up with the local-government structure. Local government forms and practices were copied 50 years ago largely from the East and Middle West. Counties were organized for political purposes and with a misconception of the future possibilities in land use. In the delineation of their boundaries difficult and inefficient administrative units were established.

With the changing and increasingly unequal geographical distribution of taxable property the support of the fundamentals of education by organized school districts is becoming impractical, even with the present State and county aids. The heavy and erratic local tax burden may impose a severe obstacle to the private ownership of land for forest-growing purposes. The forfeiture and public acquisition of cut-over and nonagricultural land aggravates the fiscal difficulties of governmental organization.

The Forest Taxation Inquiry (M.P. 218, pp. 622-625) has pointed out the desirability of the reorganization of local government in the interest of increased political vitality and better and more efficient administration; and it has pointed out the possible applicability of the unorganized territory form of government to sparsely settled forest areas. Because it was desirable to know in some detail how these suggested reforms might be applied in Oregon and Washington and their possible effect on the tax burden on forests, the Station has undertaken studies in local government. Such studies were completed during the year in Clallam County, Washington, and were begun in Tillamook and Klamath Counties, Oregon, and in Stevens County, Washington. (Studies were made of Skamania and Pacific Counties, Washington, in 1937.) The present lack of any standards in the costs and in the quality of the various services of county and school-district government make it difficult to predict the possible property-tax rates with local government fully adapted to the needs of the area served. Nevertheless, in these counties, which were chosen as representative of conditions on both sides of the Cascade Mountains, it has been shown that there are great possibilities in reducing and stabilizing the property-tax burden on forest properties and of strengthening the effectiveness of the local self-government units--in spite of a reduced tax base due to the removal of the timber resources by cutting and fire and the public acquisition of lands.

Special Forest Tax Legislation. Plats showing the locations of lands classified under special yield tax laws were compared with the Forest Survey maps in three Oregon and two Washington counties. The result was a classification of "classified reforestation" lands by Survey types. From 25 percent to 75 percent of the lands taxed under the

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special laws were found to be deforested lands or recent cutovers with unsatisfactory stocking.

In special forest tax legislation, present or proposed, nothing has been found which would be as satisfactory in overcoming the inherent defects of the property tax as the proposals in the formal report of the Forest Taxation Inquiry.

RANGE INVESTIGATIONS

As in 1937, the primary effort of the division during the past year has been directed at formulating more satisfactory standards of utilization on important types of summer range in eastern Oregon and Washington. In addition, however, a program for future research on range problems confronting the administration of grazing on the national forests of Region 6 has been formulated and plans are being perfected for going ahead on the most important of these in 1939. The problem deemed in most urgent need of research is the rehabilitation of mountain meadows and other depleted areas of high potential grazing capacity on cattle summer range in the Blue Mountain area.

Western Range Survey. The Cooperative Western Range Survey project, in which the Experiment Station actively participated as coordinator, is completed insofar as the present working agreement contemplates. Pending resumption of work on the project, the coordinating activity of the Interagency Committee, consisting of representatives of all public agencies interested in the administration of range lands, is being continued. Outstanding in the accomplishments of the project was the cooperation and unified action of the agencies involved in securing field data, in analyzing them, and in preparing plans for future use in managing the range resource of the two counties (Morrow, Oregon, and Kittitas, Washington) involved, totaling 1,720,530 acres of range land actually surveyed. The grazing capacities approved by the cooperating agencies for the lands surveyed were, for Kittitas 78,606 animal months, for Morrow 123,690 animal months. Need for major adjustments in range management in both counties is apparent from the fact that a total of 718,000 acres of range land in the two counties was found to have suffered a serious reduction in grazing capacity through overgrazing, drought, and mismanagement, and, because of the present insufficient plant cover, is actively eroding. The need for improvement of these lands was stressed by the committee and principal recommendations to aid the restorative process, listed somewhat in the order of priority, were as follows: (1) reduction of stocking to or below the sustained grazing capacity of lands on which restoration of the plant cover is needed; (2) procuring more even distribution of livestock, chiefly by developing permanent water on areas not now supplied; (3) providing adequate opportunity for range plants to build up vigor and revegetate by deferring and rotating grazing on depleted lands; (4) discontinuance of summer grazing on 265,800 acres of

early spring-late fall range; (5) better methods of handling livestock, such as reduction of trailing, discontinuance of semipermanent bedgrounds, etc.; and (6) reduction of the mileage of stock driveways by 66 percent.

Utilization Standards. Tentative standards have been established for the utilization of two important forage types within the region on the basis of grazing by sheep. These types, occurring near or above timberline in the Cascade and Blue Mountains, are the green fescue (Festuca viridula) - subalpine needlegrass (Stipa columbiana) and the subalpine needlegrass - sedge (Carex festivella) associations. The latter type undoubtedly is in a lower ecological stage than the former, which is at present considered to be near climax in succession at these elevations. On the experimental areas studied, the green fescue - subalpine needlegrass type produced 1,200 pounds of herbage per acre (green weight) 19.1 percent of which properly can be used if it is desired to stabilize soil and forage on the area. Under this degree of use, about 50 percent of the current herbage production of green fescue will be taken and about a 3-inch stubble of the grass, on the average, will remain following grazing. Subalpine needlegrass should be used 15 percent, sedge 15 percent, and fleeceflower 5 percent under this grazing intensity; shrubs as a class virtually should be ungrazed. If the management objective on subalpine needlegrass - sedge types is to maintain the present soil and cover condition, but to halt further retrogression, not more than 17 percent of the total green-weight production, which on the areas studied approximated 1,400 pounds per acre, should be used. Subalpine needlegrass under these conditions will be grazed about 45 percent, sedge 45 percent, and fleeceflower 10 percent, based on weight of forage produced. If it is desired to allow the type to advance to a climax or near-climax stage, it will be necessary to reduce the intensity of grazing from one-half to two-thirds in order that species naturally more palatable and ecologically more nearly climax than needlegrass, sedge, and fleeceflower may increase. On many depleted areas that have reverted to the subalpine needlegrass type, such treatment is called for in the interest of soil and water conservation.

Close observations on the study areas emphasized the vital need of good herding methods to meet either a maintenance or a restoration objective on either of the foregoing range types. In particular, on steep lands where these types generally occur, care should be taken to avoid useless trailing and also undue concentration of use in favored sites such as stream courses, basins, and the more succulent vegetation near small hillside seeps. The delicate soil-vegetation balance on these forage types calls for a "once-over" system of grazing, with no regrazing permitted later in the season. Excessively steep slopes should be used lightly, if at all.

Forage Measurement. Results from studies in the use of the square-foot-density method on the subalpine needlegrass type indicate

that it will give a reliable measure of range forage where an intensive examination is being made. However, the variability of natural vegetation is such that to sample a range varying widely in forage production with such intensity that the maximum error does not exceed 10 percent will require more plots than is practical in ordinary range studies. This error should be considered when interpreting field data obtained by the square-foot-density method and when applying results based upon such data. For intensive sampling where detailed studies are being made of the vegetation, approximately 500 plots are needed within each unit sampled, whereas for more extensive or "reconnaissance" types of forage inventory approximately 125 plots should give satisfactory results. The intensive sampling provides for an error greater than 10 percent once in twenty trials. The extensive sampling will permit error in excess of 10 percent in one out of three trials. The weight-estimate method has also been tested and is shown to give reliable estimates of actual current forage production. The weight-estimate method required approximately 70 percent as many plots as required by the square-foot-density method.

Ocular estimates of the percent of forage removed on a series of sample plots proved to be the simplest for field use and in office compilation and gave as close an estimate of the actual forage removed as any other method studied. The method whereby measurements of average stubble heights are converted to percentage use by means of utilization tables that give the percent of forage removed at different height intervals above the ground proved to be more cumbersome in use than the ocular-estimate method.

An individual's errors in estimating plant density by the square-foot-density method or weight of forage produced by the weight-estimate method were found not to be compensating, i.e., they do not tend to alternate above and below the true values sufficiently to give averages that differ inconsequentially from actual density or weight. If a man's tendency is to estimate low he does so consistently, and if he tends to estimate high, he likewise does so consistently. Estimates of four men on 145 plots indicated those of any one man to be as consistent to his individual conceptions of density or weight as those of any other. However, the individual conceptions varied as much as 10 percent from the actual. This demonstration of individualities stresses the advantage of using several men for sampling a tract of range land. While a single individual may estimate either consistently high or consistently low, the average of a group of individuals working on parts of the same area may compensate and, for practical purposes, nullify any error due to individual variations.

Plans for 1939. The Western Range Survey will be continued in the assembly phase if emergency or regular funds become available. Three and one-half million acres of survey in counties other than Kittitas and Morrow are available for assembly and analysis. Work on utilization standards will be continued along similar lines as in 1938.

If funds are available it is also proposed to detail two qualified men for a period of one year to the Utilization Standards project, one from the Regional Office and one from the Experiment Station, to canvass range-forage conditions over the entire region and to work out tentative utilization standards for the major range types. Major emphasis for 1939, however, will be placed in establishing research on the rehabilitation of depleted meadows on cattle summer range in the Blue Mountain area. Exploratory work in selecting an area on which to work is partially finished and will be completed and an area selected by early spring. Over-all plans for the project have been prepared in advance of specific plans that must await actual selection of the area. The broad objective of the study is to determine what methods of cattle management will prevent over-use of mountain meadows and thereby allow these key areas to build up to their potentially high grazing capacity and at the same time permit reasonably full use of the surrounding pine-grass-bunchgrass forage on timbered slopes. A cooperative study of range survey methods is contemplated also for 1939 with the objective of determining the best and most practical method of making range surveys in national forests. This study is scheduled to be completed by June 30, 1940.

FLOOD CONTROL SURVEYS

This is the second year that flood control has been recognized as a distinct and important activity at the Pacific Northwest Forest Experiment Station. There are three steps in the flood control program:

1. A preliminary examination of a watershed to determine the extent of the flood problem, the damage done, and the flood source areas and to ascertain the feasibility of a flood control project.

2. A detailed survey of the critical areas in the watershed to develop the specification program and to determine its costs and benefits.

3. The actual flood control operation.

Preparation of preliminary flood control reports authorized by the Flood Control Act of 1936 was carried on throughout the year. Reports on the following watersheds have been completed and transmitted to Washington:

Stream	Location	Date Completed
Walla Walla River	Southeastern Washington	March 1938
Chehalis River	Western Washington	June 1938
Skagit River	Northwestern Washington	June 1938
Lowell Creek	Alaska	December 1938

The investigations showed that on the Walla Walla, Chehalis, and Skagit watersheds the flood and erosion problems had been accentuated

by improper land use. The degree to which these problems can be corrected by watershed treatment is unknown, but a detailed watershed survey was recommended for the agricultural and denuded forest lands on these rivers. The problem seemed to be most pressing on the Walla Walla where a field trip revealed destructive erosion to an astonishing degree. Considerable work has also been done on reports for the Nooksack, Willamette, Yakima, Puyallup, and John Day drainages.

During the year a complete change was made in the personnel of Field Flood Control Coordinating Committee 22. On July 1, Mr. S. N. Wyckoff became the new chairman and Mr. Selby, who represented the Bureau of Agricultural Economics, was replaced by Mr. Ade following the consolidation of western offices in that bureau. On July 15, Mr. Christ of the Soil Conservation Service took Mr. Rockie's place on the committee. Also, Mr. H. J. Andrews, who had been in charge of the immediate supervision of this work at the Station, left governmental service.

Flood Damage. A compilation of flood damages for the various watersheds as estimated by the Army Engineers shows that the average annual loss in Oregon and Washington west of the Cascades is about $3,170,000. The Willamette watershed sustains an average annual loss greater than that of all the other streams combined. The extent to which this damage can be reduced by vegetative and minor engineering measures is unknown but a detailed survey to obtain the factual data necessary to determine this has been recommended.

Drainage Basin Problems and Programs. The National Resource Committee report "Drainage Basin Problems and Programs" is again being revised to present a systematic plan for each basin in contrast to mere listing of projects for the unified control and use of water. This work was begun in November and members of the Station working on flood control are assisting in this task. It is expected that this will require considerable time during the first half of 1939.

Special Investigations. A study was made of the precipitation and snow conditions before and during flood periods to determine the effect of snow melt upon run-off during major floods. The records for the nine meteorological stations in western Washington over 1,200 feet in elevation were analyzed. The data are meager, but several interesting tendencies were noted.

1. Snow storage below about 2,000 feet is generally light and the run-off from it is gone prior to the development of serious flood conditions, hence below this elevation melting snows contribute little or nothing to run-off at the flood peak.

2. At elevations over about 2,000 feet run-off from melting snows is a source of flood water to a varying degree, depending upon elevation, exposure, and climatic conditions.

3. Comparison of the estimated water content of the snow melted during a 72-hour period prior to the flood peak with the rainfall for a like period indicates that the run-off from melting snow is but a small part, generally less than 20 percent of that from rain.

PERSONNEL

Three events during 1938 materially influenced the organization of work at the Pacific Northwest Forest Experiment Station. On July 1 Thornton T. Munger, Director at the Station since its establishment in 1924, was transferred upon his own request from executive duties to technical work as Chief of the Division of Forest Management Research at this Station. Stephen N. Wyckoff was transferred from Director of the Northern Rocky Mountain Forest and Range Experiment Station to fill the position vacated at this Station. In August H. J. Andrews, regional director of the Forest Survey since 1930, accepted appointment to the faculty of the Forest School at the University of Michigan.

The regular personnel now consists of the following:

Stephen N. Wyckoff	Director
Thornton T. Munger	Principal Silviculturist
Axel J. F. Brandstrom	Senior Forest Economist
Sinclair A. Wilson	Senior Forest Economist
Wade DeVries	Senior Forest Economist
J. Elton Lodewick	Senior Silviculturist
Robert W. Cowlin	Senior Forest Economist
Gerald D. Pickford	Senior Forest Ecologist
Donald N. Matthews	Silviculturist
Herman M. Johnson	Associate Forester
Floyd L. Moravets	Associate Forester
Philip A. Briegleb	Associate Silviculturist
Leo A. Isaac	Associate Silviculturist
Ernest L. Kolbe	Associate Silviculturist
William G. Morris	Assistant Silviculturist
Warren H. Bolles	Assistant Forester
Edward D. Buell	Assistant Forester
Eric A. Anderson	Junior Forester
Earl G. Dunford	Junior Forester
Elbert H. Reid	Junior Range Examiner
June H. Wertz	Administrative Assistant
Christina M. McPhail	Clerk-Stenographer
Frances Elliott	Clerk-Stenographer
Inga E. Pierce	Clerk
Edna L. Hunt	Assistant Clerk-Stenographer
Evelyn L. Berg	Assistant Clerk-Stenographer
Dorothy E. Rude	Assistant Clerk-Stenographer
Ruth E. Hickman	Junior Clerk-Stenographer
Leona M. Stevens	Junior Clerk-Stenographer
Erna Jeppesen	Under Assistant Librarian

Upon July 1 appropriation of emergency funds for research under CCC was terminated, which necessitated drastic changes in the personnel of the Station. George Meagher, under CCC appointment as Junior Forester, transferred to a permanent position at the Southwestern Forest and Range Experiment Station. A. W. Hodgman, under CCC Junior Forester appointment

on the survey, transferred to a permanent position in Region 10. The remaining personnel, both appointed and unappointed, being paid from CCC funds were released through lack of any other means of continuing their employment.

John C. Wilkinson, Junior Forester paid from administrative funds from the Regional Forester's office, was detailed to the Station on fire studies for the entire year. Two Assistant to Technicians, also paid by the Regional Forester's office, were employed part of the year on the fire control replanning project under direction of this Station. Two Junior Foresters detailed from the Regional Office were assigned to the Station for work on thinning studies, and one Junior Forester and one Assistant to Technician were assigned, respectively, to the Wind River and Pringle Falls Experimental Forests by the Regional Office. Eleven field assistants were employed during the year by the Division of Forest Management; two by the Division of Forest Economics; one Junior Forester, three Assistant Scientific Aides, four field assistants, and one draftsman by the Forest Survey; and one Junior Range Examiner, three Assistant to Technicians, five field assistants, two draftsmen, and nine clerks by Range Investigations, including the Western Range Survey.

Miss Jean Kerr, Editor from the Washington office, left in late March for an assignment to the Lake States Forest Experiment Station after being detailed to this Station for several years.

Under the emergency relief appropriation the Station was allotted the quota of 55 men per month for the calendar year. The entire quota was delivered, 585 man months at the experimental forests and 78 man months in the office. At four of the experimental forests squads of CCC boys were used part of the year, chiefly on stand improvement growth construction and hazard reduction work.

LIBRARY

During the year 1938, 15 books and 665 pamphlets or reprints were classified and added to the Station library. Much less was spent on books than during the preceding years. However, a subscription to the Agricultural Index was placed and it is a valuable tool as seven of the magazines to which we subscribe regularly are indexed therein. As the years go by and we receive the cumulative volumes this will be of increasing usefulness.

For the first time in five years we were allotted an amount of money to do our most urgent binding. We were thus able to have bound the Journal of Forestry for the four years, 1934-37, as well as the three-volume set "Lumber Industry" by the U. S. Department of Commerce and two of our most worn books on plant identification.

Three hundred and seventy-four new photographs were sent in to the Washington office for its negative collection and the prints classified and added to our photograph collection. Some of the best of these were taken by the Division of Grazing.

The librarian revised and reissued the list of publications of the Station which she compiled in 1935. Various publications were mailed by the librarian and the mailing list kept up to date. An addressograph belonging to the Regional Office was transferred to this Station when they purchased a new machine.

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APPENDIX - LIST OF CURRENT RESEARCH PROJECTS

Following are the file designations and titles of the current research projects approved by the North Pacific Research Committee for the year 1938. This list does not include the projects of cooperating agencies--the Forest Insect Field Station, the Office of Forest Pathology, and the Biological Survey--nor the "administrative studies" conducted by national forest officers.

Many of these projects are broadly worded and very inclusive, and are continued year after year; however, different phases of such projects are taken up successively and concluded.

M-1	Silviculture of the Douglas fir region; the silvical and ecological aspects of regeneration, as well as basic silvical study of Douglas fir, Sitka spruce, western hemlock, and red alder, and silvicultural aspects of selective logging in this region covering fire protection, growth, regeneration, and related phases.
M-2	Management and silvics of ponderosa pine, particularly effects of various types of selective cutting.
B-1	Phenology of forest trees and associated vegetation.
Mt-1	Stand improvement in immature and overmature forests of the Douglas fir region.
Mt-2	Stand improvement in the ponderosa pine region.
Fp, Fn, and Fs	Study of out-planting technique, nursery, practice, genetic traits of various strains of Douglas fir and ponderosa pine seeds, and tests of exotic species.
ME-2 Growth Cycles	Growth cycles in ponderosa pine trees.
ME-1 and ME-2	Growth and yield of all types in Douglas fir and ponderosa pine regions.
Pf-1 Control	Means of improving present techniques of the presuppression, detection, and suppression phases of fire protection.
Pf-2 Behavior	Factors which influence fire spread and behavior.
Pf-3	Fire damage, including silvicultural effects of fire, and use and effectiveness of fire in removing the fuel hazard after logging.

RP-Mill Studies	Grade production and cost studies in Douglas fir and ponderosa pine sawmills of various sizes.
RP -Species Utilization	The economics and utilization of Oregon and Washington minor species and minor forest products.
RP-Properties of Wood	Miscellaneous studies and service tests of the properties, identification, utilization, and durability of local woods.
RE Statistics	Statistical studies of production, distribution, and prices of forest products, including the annual lumber, lath, shingle, and log census in cooperation with the U. S. Bureau of the Census.
RE Forest Survey D.F. Region	The forest survey of the Douglas fir region, including filling requests for special data, service jobs, and revision of inventory in certain counties.
RE Forest Survey Ponderosa Pine	The forest survey of the ponderosa pine region. Preparation of comprehensive regional report and special reports, and service jobs. (Office work only.)
RE-Economics of Forestry Douglas Fir	Selective timber management in Douglas Fir.
RE-Economics of Forestry Ponderosa Pine	Selective timber management in ponderosa pine.
RE Log Transport	Motor truck log hauling costs.
RE-Machinery Design	Design and development of "forestry designed" logging machinery to promote better woods practice.
RE-New Public Domain	Tax delinquency and abandonment of forest lands, Oregon and Washington.
RE-Taxation Case Studies	Study in sample counties of relationship of property tax and local government reorganization and finance to the economics of forest ownership. Analysis of existing and proposed tax laws.
RM-3 Cooperation Western Range Survey	Preparation with cooperative agencies of a complete type map and the inventorying of the vegetative cover and grazing capacity value of all range lands in the Pacific Northwest region.

RM-4 Utilization Standards	Determination of standards of satisfactory forage utilization on summer ranges of eastern Oregon and Washington.
RM-1 Management of Summer Ranges West Side	Grazing management studies on the mountainous summer ranges, particularly logged-off lands, of the Douglas fir region.
RM-2 Management of Summer Ranges East Side	Grazing management studies on summer cattle ranges of the ponderosa pine region.
*RM-Comparison of Range Survey Methods	Determination of most desirable methods of range surveys for use on national forests.
*R Influences FCS	Preliminary surveys to determine the need for detailed studies of run-off, waterflow retardation, and soil erosion prevention on specified watersheds.

*New project, or segregated as new project this year.